

AMENDMENTS TO THE CLAIMS

1-37. (Cancelled)

38. (Currently Amended) An audio system for optimizing playing of an audio program, which includes a preferred audio signal and a remaining audio signal, for end users, which includes both hearing impaired and non-hearing impaired listeners, comprising:

- a) a first end user adjustable amplifier for receiving the preferred audio signal and a first gain selected by an end user, and for amplifying the preferred audio signal to a level corresponding to the first gain specified by the user, said first end user adjustable amplifier having a range of amplification from zero to a maximum value, and said first end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the first gain selected by the end user of the first end user adjustable amplifier;
- b) a second end user adjustable amplifier for receiving the remaining audio signal and a second gain selected by the end user, and for amplifying the remaining audio signal to a level corresponding to the second gain specified by the user, said second end user adjustable amplifier having a range of amplification from zero to a maximum value, and said second end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the second gain selected by the end user of the second end user adjustable amplifier; and
- c) a corrector circuit for receiving as a first input the control output of the first end user adjustable amplifier, for receiving as a second input the control output of the second end user adjustable amplifier, for calculating a desired preferred audio signal to remaining audio signal ratio based on the first input and the second input, for receiving as a third input the output of the first end

user adjustable amplifier, for receiving as a fourth input the output of the second end user adjustable amplifier, and for modifying the output of the first end user adjustable amplifier and the output of the second end user adjustable amplifier so that the actual preferred audio signal to remaining audio signal (PSRA) ratio corresponds to the ~~end-user-calculated~~ desired value of the preferred audio signal to remaining audio signal (PSRA) ratio.

39. (Previously Presented) The system according to claim 38, wherein the corrector circuit comprises:

- a) a first divider for receiving as a numerator input the control output of the first end user adjustable amplifier, for receiving as a denominator input the control output of the second end user adjustable amplifier, and for outputting the result of the numerator input divided by the denominator input, which represents the end user desired preferred audio signal to remaining audio signal (PSRA) ratio;
- b) a first vector accumulator coupled to the output of the first end user adjustable amplifier, for storing vector samples of the preferred audio signal;
- c) a second vector accumulator coupled to the output of the second end user adjustable amplifier for storing vector samples of the remaining audio signal;
- d) a first peak level detector coupled to the output of the first vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the preferred audio signal represented by the vector samples in the first vector accumulator;
- e) a second peak level detector coupled to the output of the second vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the remaining audio signal represented by the vector samples in the second vector accumulator;
- f) a second divider for receiving as a numerator input the output of the first peak level detector representing the transient amplitude of the segment of

the preferred audio signal represented by the vector samples in the first vector accumulator, for receiving as a denominator input the output of the second peak detector representing the transient amplitude of the segment of the remaining audio signal represented by the vector samples in the second vector accumulator, and for outputting the result of the numerator input divided by the denominator input representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio;

- g) a third divider for receiving as a numerator input the output of the first divider representing a desired value of the preferred audio signal to the remaining audio signal (PSRA) ratio, for receiving as a denominator input the output of the second divider representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio, and for outputting the result of the numerator input divided by the denominator input, which represents a difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio; and
- h) a first multiplier for receiving as a first input the preferred audio signal, for receiving as a second input the output of the third divider, and for multiplying the output of the third divider and the preferred audio signal and for outputting the result, which is a corrected value of the user setting of the preferred audio signal to the remaining audio signal (PSRA) ratio.

40. (Previously Presented) The system according to claim 38, wherein the corrector circuit comprises:

- a) a first divider for receiving as a numerator input the control output of the first end user adjustable amplifier, for receiving as a denominator input the control output of the second end user adjustable amplifier, and for outputting the result of the numerator input divided by the denominator input, which represents the end user desired preferred audio signal to remaining audio signal (PSRA) ratio;

- b) a first vector accumulator coupled to the output of the first end user adjustable amplifier, for storing vector samples of the preferred audio signal;
- c) a second vector accumulator coupled to the output of the second end user adjustable amplifier for storing vector samples of the remaining audio signal;
- d) a first peak level detector coupled to the output of the first vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the preferred audio signal represented by the vector samples in the first vector accumulator;
- e) a second peak level detector coupled to the output of the second vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the remaining audio signal represented by the vector samples in the second vector accumulator;
- f) a second divider for receiving as a numerator input the output of the first peak level detector representing the transient amplitude of the segment of the preferred audio signal represented by the vector samples in the first vector accumulator, for receiving as a denominator input the output of the second peak detector representing the transient amplitude of the segment of the remaining audio signal represented by the vector samples in the second vector accumulator, and outputting the result of the numerator input divided by the denominator input representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio;
- g) a third divider for receiving as a numerator input the output of the first divider representing a desired value of the preferred audio signal to the remaining audio signal (PSRA) ratio, for receiving as a denominator input the output of the second divider representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio, and for outputting the result of the numerator input divided by the denominator input, which represents a difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio;

- h) a fourth divider having as a denominator input the output of the third divider, and for dividing one by the output of the third divider; and
- i) a multiplier for receiving as a first input the remaining audio signal, for receiving as a second input the output of the fourth divider and for multiplying the output of the fourth divider and the remaining audio signal and for outputting the result, which is the corrected value of the user setting of the preferred audio signal to the remaining audio signal (PSRA) ratio.

41. (Currently Amended) The system according to claim ~~38~~39, wherein the first and second vector accumulators include user selectable vector sizes.

42. (Currently Amended) An audio system for optimizing playing of an audio program, which includes a preferred audio signal and a remaining audio signal, for end users, which includes both hearing impaired and non-hearing impaired listeners, comprising:

- a) a plurality of user selectable frequency dependent amplification devices, each device for establishing a preferred audio signal to remaining audio (PSRA) over a separate frequency band, and each of the plurality of user selectable frequency dependent amplification devices including:
 - (i) a first bandpass filter for receiving the preferred audio signal and for filtering out everything within the preferred audio signal except for a predetermined bandwidth of the preferred audio signal;
 - (ii) a second bandpass filter for receiving the remaining audio signal and for filtering out everything within the remaining audio signal except for a predetermined bandwidth of the remaining audio signal;
 - (iii) a first end user adjustable amplifier for receiving the predetermined bandwidth of the preferred audio signal and a first gain selected by an end user, and for amplifying the predetermined bandwidth of the preferred audio signal to a level corresponding to the first gain

- specified by the user, said first end user adjustable amplifier having a range of amplification from zero to a maximum value, and said first end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the first gain selected by the end user of the first end user adjustable amplifier;
- (iv) a second end user adjustable amplifier for receiving the predetermined bandwidth of the remaining audio signal and a second gain selected by the end user, and for amplifying the predetermined bandwidth of the remaining audio signal to a level corresponding to the second gain specified by the user, said second end user adjustable amplifier having a range of amplification from zero to a maximum value, and said second end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the second gain selected by the end user of the second end user adjustable amplifier; and
- (v) a corrector circuit for receiving as a first input the control output of the first end user adjustable amplifier, for receiving as a second input the control output of the second end user adjustable amplifier, for calculating a desired preferred audio signal to remaining audio signal ratio based on the first input and the second input, for receiving as a third input the output of the first end user adjustable amplifier, for receiving as a fourth input the output of the second end user adjustable amplifier, and for modifying the output of the first end user adjustable amplifier and the output of the second end user adjustable amplifier so that the actual preferred audio signal to remaining audio signal (PSRA) ratio for the predetermined bandwidth corresponds to the ~~end user~~calculated desired value of the preferred audio signal to remaining audio signal (PSRA) ratio for the predetermined bandwidth; and

- b) a summing amplifier for receiving the outputs of all of the plurality of user selectable frequency dependent amplification devices to create a total audio signal.

43. (Previously Presented) The system according to claim 42, wherein each of the corrector circuits comprises:

- a) a first divider for receiving as a numerator input the control output of the first end user adjustable amplifier, for receiving as a denominator input the control output of the second end user adjustable amplifier, and for outputting the result of the numerator input divided by the denominator input, which represents the end user desired preferred audio signal to remaining audio signal (PSRA) ratio;
- b) a first vector accumulator coupled to the output of the first end user adjustable amplifier, for storing vector samples of the preferred audio signal;
- c) a second vector accumulator coupled to the output of the second end user adjustable amplifier for storing vector samples of the remaining audio signal;
- d) a first peak level detector coupled to the output of the first vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the preferred audio signal represented by the vector samples in the first vector accumulator;
- e) a second peak level detector coupled to the output of the second vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the remaining audio signal represented by the vector samples in the second vector accumulator;
- f) a second divider for receiving as a numerator input the output of the first peak level detector representing the transient amplitude of the segment of the preferred audio signal represented by the vector samples in the first vector accumulator, for receiving as a denominator input the output of the second peak detector representing the transient amplitude of the segment of

the remaining audio signal represented by the vector samples in the second vector accumulator, and for outputting the result of the numerator input divided by the denominator input representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio;

- g) a third divider for receiving as a numerator input the output of the first divider representing a desired value of the preferred audio signal to the remaining audio signal (PSRA) ratio, for receiving as a denominator input the output of the second divider representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio, and for outputting the result of the numerator input divided by the denominator input, which represents a difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio; and
- h) a first multiplier for receiving as a first input the preferred audio signal, for receiving as a second input the output of the third divider, and for multiplying the output of the third divider and the preferred audio signal and for outputting the result, which is a corrected value of the user setting of the preferred audio signal to the remaining audio signal (PSRA) ratio.

44. (Previously Presented) The system according to claim 42, wherein each of the corrector circuits comprises:

- a) a first divider for receiving as a numerator input the control output of the first end user adjustable amplifier, for receiving as a denominator input the control output of the second end user adjustable amplifier, and for outputting the result of the numerator input divided by the denominator input, which represents the end user desired preferred audio signal to remaining audio signal (PSRA) ratio;
- b) a first vector accumulator coupled to the output of the first end user adjustable amplifier, for storing vector samples of the preferred audio signal;

- c) a second vector accumulator coupled to the output of the second end user adjustable amplifier for storing vector samples of the remaining audio signal;
- d) a first peak level detector coupled to the output of the first vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the preferred audio signal represented by the vector samples in the first vector accumulator;
- e) a second peak level detector coupled to the output of the second vector accumulator, wherein the first peak detector for calculating a transient amplitude of a segment of the remaining audio signal represented by the vector samples in the second vector accumulator;
- f) a second divider for receiving as a numerator input the output of the first peak level detector representing the transient amplitude of the segment of the preferred audio signal represented by the vector samples in the first vector accumulator, for receiving as a denominator input the output of the second peak detector representing the transient amplitude of the segment of the remaining audio signal represented by the vector samples in the second vector accumulator, and for outputting the result of the numerator input divided by the denominator input representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio;
- g) a third divider for receiving as a numerator input the output of the first divider representing a desired value of the preferred audio signal to the remaining audio signal (PSRA) ratio, for receiving as a denominator input the output of the second divider representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio, and for outputting the result of the numerator input divided by the denominator input, which represents a difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio;
- h) a fourth divider having as a denominator input the output of the third divider, and for dividing one by the output of the third divider; and

- i) a multiplier for receiving as a first input the remaining audio signal, for receiving as a second input the output of the fourth divider and for multiplying the output of the fourth divider and the remaining audio signal and for outputting the result, which is the corrected value of the user setting of the preferred audio signal to the remaining audio signal (PSRA) ratio.

45-52. (Cancelled)

53. (Withdrawn) A method for optimizing playing of an audio program, the audio program including a preferred audio signal and a remaining audio signal output to end users, the end users including both hearing impaired and non-hearing impaired listeners, comprising:

- amplifying the preferred audio signal to a level specified by the user;
 - amplifying the remaining audio signal to a level specified by the user;
 - computing a first ratio, the first ratio being a ratio of preferred audio signal level and the remaining audio signal level as specified by the user;
 - computing the transient amplitude of the preferred audio signal;
 - computing the transient amplitude of the remaining audio signal;
 - generating a second ratio, the second ratio being a ratio of the computed preferred audio signal transient amplitude to an instantaneous amplitude of the preferred audio signal;
 - generating a third ratio, the third ratio being a ratio of the computed secondary audio transient amplitude to an instantaneous amplitude of the remaining audio signal;
 - modifying the preferred audio signal based on the second ratio; and
 - modifying the remaining audio signal based on the third ratio;
- wherein the preferred audio signal and the remaining audio signal are modified to maintain the first ratio during transient changes in at least one of the preferred audio signal and the remaining audio signal.

54. (Cancelled)

55. (Currently Amended) A method for optimizing playing of an audio program for end users including both hearing impaired and non-hearing impaired listeners, which includes a preferred audio signal and a remaining audio signal, comprising:

- a) receiving the preferred audio signal and a first gain selected by an end user, and amplifying the preferred audio signal to a level corresponding to the first gain specified by the user using a first end user adjustable amplifier having a range of amplification from zero to a maximum value, and said first end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the first gain selected by the end user of the first end user adjustable amplifier;
- b) receiving the remaining audio signal and a second gain selected by the end user, and amplifying the remaining audio signal to a level corresponding to the second gain specified by the user using a second end user adjustable amplifier having a range of amplification from zero to a maximum value, and said second end user adjustable amplifier having as a control output a gain selection value representing a numerical value of the second gain selected by the end user of the second end user adjustable amplifier; and
- c) receiving as a first input the control output of the first end user adjustable amplifier using a corrector circuit, receiving as a second input the control output of the second end user adjustable amplifier, calculating a desired preferred audio signal to remaining audio signal ratio based on the first input and the second input, receiving as a third input the output of the first end user adjustable amplifier, receiving as a fourth input the output of the second end user adjustable amplifier, and modifying the output of the first end user adjustable amplifier and the output of the second end user adjustable amplifier so that the actual preferred audio signal to remaining audio signal

(PSRA) ratio corresponds to the ~~end-user~~calculated desired value of the preferred audio signal to remaining audio signal (PSRA) ratio.

56. (Previously Presented) The method according to claim 55, wherein the corrector circuit performs:

- a) receiving as a numerator input the control output of the first end user adjustable amplifier, receiving as a denominator input the control output of the second end user adjustable amplifier, and outputting the result of the numerator input divided by the denominator input, which represents the end user desired preferred audio signal to remaining audio signal (PSRA) ratio;
- b) storing vector samples of the preferred audio signal;
- c) storing vector samples of the remaining audio signal;
- d) calculating a transient amplitude of a segment of the preferred audio signal represented by the vector samples of the preferred audio signal;
- e) calculating a transient amplitude of a segment of the remaining audio signal represented by the vector samples of the remaining audio signal;
- f) receiving as a numerator input the transient amplitude of the segment of the preferred audio signal, receiving as a denominator input the transient amplitude of the segment of the remaining audio signal, and outputting the result of the numerator input divided by the denominator input representing an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio;
- g) receiving as a numerator input a desired value of the preferred audio signal to the remaining audio signal (PSRA) ratio, receiving as a denominator input an actual value of the preferred audio signal to the remaining audio signal (PSRA) ratio, and outputting the result of the numerator input divided by the denominator input, which represents a difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio; and

- h) receiving as a first input the preferred audio signal, receiving as a second input the output of the third divider, and multiplying the difference between the desired and actual values of the preferred audio signal to the remaining audio signal (PSRA) ratio and the preferred audio signal and for outputting the result, which is a corrected value of the user setting of the preferred audio signal to the remaining audio signal (PSRA) ratio.

57. (Currently Amended) The method according to claim ~~55~~56, wherein the size of the vector samples are user selectable.